

Measurement of Physical Workload Ergonomic Risk Levels in Work Postures Using the Owas and Reba Methods at PLN UP3 Gresik

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ABSTRACT

This research was conducted at PLN UP3 Gresik to evaluate the sitting posture of employees and determine its alignment with ergonomic standards. The study aimed to improve employee posture to ensure a safer and more comfortable work environment. Sixteen workers participated in the study, which involved observations, interviews, and the distribution of questionnaires to identify issues related to work posture. The OWAS (Ovako Working Posture Analysis System) and REBA (Rapid Entire Body Assessment) methods were employed based on established literature. The findings revealed a mismatch between the design of tables and chairs and ergonomic requirements. According to the OWAS method, the work posture code was 2, indicating the need for corrective action. The REBA method showed angular values of 7 for group A, 4 for group B, and 8 for group C, all suggesting a need for improvement due to musculoskeletal complaints. Data were gathered through Nordic Body Map (NBM) questionnaires and photo analyses of workers' postures. The study concludes that corrective actions are necessary, recommending that the company design seats based on workers' anthropometric data and conduct periodic evaluations to ensure ongoing comfort and safety.

Keywords: Ovako Work Analysis System (OWAS), Rapid Entire Body Assessment (REBA), Ergonomics, Work Posture Evaluation.

Introduction

At the research site, the researcher was located at PLN UP3 GRESIK, a state-owned company providing the largest power plant. The author himself conducted research at PLN UP3 GRESIK for 1 month, and the results obtained were based on interviews and observations of workers. The author found a physical workload problem of work posture complaints in the sitting position of the workers with the results of the interview, namely the 16 workers who were samples of respondents who had been interviewed and observed, the workers had more than 50% of the level of muscle complaints felt, and also the value of work posture results from more than 1 which was used as a reference for researchers to be analyzed in the study. These complaints are caused by the workers' discomfort when working because the design of the tables and chairs is not based on the workers' posture. [1]

Workload is where a condition is shown by the operator who cannot complete his work. So it is necessary to measure the workload on the operator in an effort to classify the character and performance of each job so that it can be adjusted to the capabilities and abilities of the workers, especially the physical burden felt by the operator when working.[2]. Physical workload itself refers to the workload of workers who require the use of energy or physical power of human muscles, which is the source of energy for workers. These complaints being able to hinder the work of operators in completing their tasks, will have a big impact on the company they work for, therefore the analysis of employee work posture can increase the company's productivity. [3]. Understanding workload cognitively is a challenge to the existence of human factors and also ergonomics. [4]

Musculoskeletal complaints themselves occur in parts of the skeletal muscles, also called skeletal muscles, which are self-reported by the operator from mild to severe levels. Feeling the muscle complaints themselves takes a long time until the pain excruciates. This can happen because the operator does his activities repeatedly, a sign of stretching the muscles.[5]. for the level of musculoskeletal disorders themselves, and their level of seriousness. [6]. With that, the decision of the musculoskeletal level is a prerequisite and specific prevention.[7]. The impact of this musculoskeletal complaint based on the level can result in bone disability, which can reduce workers' performance, and the result is that workers experience a reduction in income. [8]. In determining the muscle complaints of workers, data

collection is done using a questionnaire for musculoskeletal complaints, namely the Nordic body map commonly referred to as NBM. In this questionnaire, there are several types of complaints from head to toe, so respondents must fill out the questionnaire according to what they feel at work. [9]

In the industrial world, the comfort of workers is one of the main factors that must be considered because the complaints of pain felt by workers can hinder unproductive work activities so that it is uncomfortable, which results in the body being in a not ergonomic state. Not only that, in the workplace if the value of ergonomics is also prioritized for the safety of workers, knowing the value of ergonomics in the workplace as the basis for a factory or industry must have the appropriate ergonomic value to minimize the risk of work accidents. We know that in the industrial world and the workplace, the value of ergonomics is interrelated. Suppose the industrial site has prioritized the value of ergonomics in the workplace. In that case, the risk of work accidents can be reduced, and the risk of accidents can even be eliminated for workers working in the workplace or field.[10] With this, research using the OWAS and REBA methods is a suitable method selection in this study because it assesses the posture of workers while sitting, such as the neck, back, arms, and wrists and feet of workers.[11]

Many previous studies have focused on the short-term impacts of sedentary work, such as worker discomfort or back pain. However, there is a lack of exploration of the long-term effects of continuous sitting, especially in the context of high cognitive load work such as computer work. Research into these long-term effects is critical to understanding the more comprehensive health and safety risks to workers, such as metabolic disorders or so-called cardiovascular disease. Also, in the previous literature, although many have evaluated workplace designs such as desks and chairs, some still do not understand the specific health context, such as providing desk and chair designs that are by the anthropometric standard size of the worker's body. Research with the sitting position itself is one of the important studies to be carried out in every workplace because the work factor with the sitting position involves the psychology of the workers. After all, if the seat is uncomfortable and the time is long working in front of the computer, it results in a very high level of stress and physical work.

The use of the OWAS and Reba methods in this study also referred from previous studies that used the same method in a sitting position, as well as work in front of a computer, such as admin or operator workers who require sitting in front of a computer for a continuous period of work, so it is focused on conducting research with a sitting position that is not ergonomic. The impact is the workers' health due to the effectiveness of the ergonomic value of good tables and chairs. Assessment with the OWAS and Reba methods can help find out or identify muscle complaints felt by workers so that improvements can be made to reduce the complaints felt, such as complaints that start from the neck back to the hands and feet. This shows that modifying the ergonomics of chairs and tables is an effective improvement and reduces musculoskeletal injuries felt by workers.

From the importance of the value of ergonomics for the industrial world and the workplace, the use of work facilities that are not suitable when sitting, such as tables and chairs, results in work posture complaints; if this is felt for a long time, it will be fatal. [12][13] Work facilities such as work tables and chairs have a standard size for people with their respective body sizes. If there is an incorrect size, it affects the results of their work. [14] At the time of work, it endeavoured that the working position is upright parallel to the table, and the back does not exceed not in a bowed position of no more than 300 degrees for approximately 2 hours. Otherwise, it will be fatal to the worker's spine. [5]. Comfortable table and chair work facilities make the body pressure experienced reasonable. [15].

With this explanation, the authors analyzed the work posture of workers at PLN UP3 Gresik to increase workers' productivity so that there were no muscle complaints using the OWAS method to reduce complaints felt by workers.[16] I also used the REBA method to determine complaints by calculating the workers' work position angle.[17] With this study, it is intended that researchers investigate the relationship between what influences the habits of workers or operators with the position facing the work computer and the muscle pain workers feel. [18] Not only that, the writing of this research is also used to evaluate improvements in the design of tables and chairs by height and comfort standards when operating. [19] This research also carves out how much body size changes when designing ergonomic tables and chairs using anthropometric data. [20]

Research Method

Research Completion Scenario

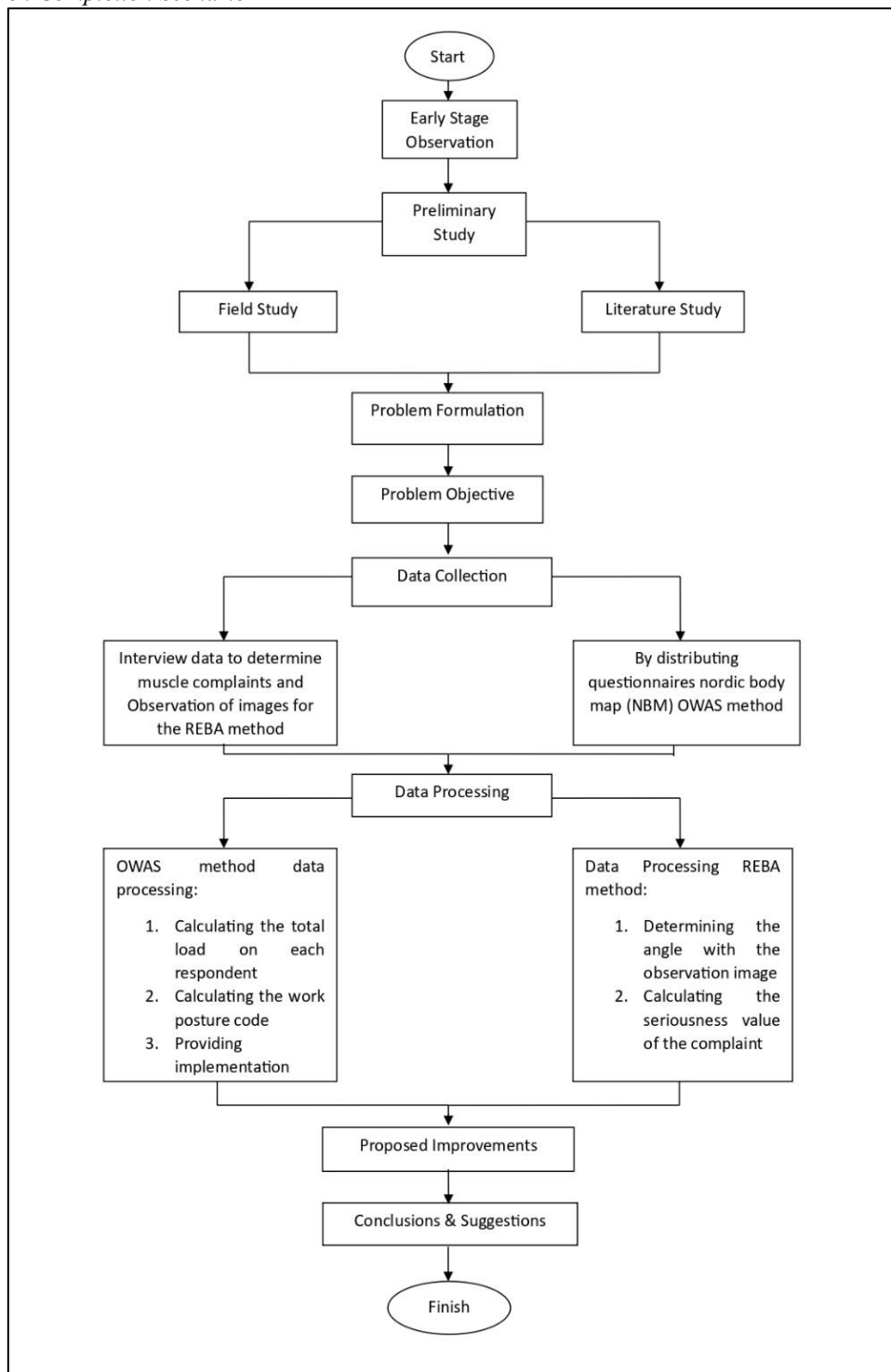


Figure 1. Research Completion Scenario

Participants / Respondents

Respondents in this study are workers or employees at PLN UP3 Gresik, which is relatively small in number so in sampling, researchers take samples using the saturated sample method. According to Sugiono 2018 "saturated sampling is to take the entire population as a sample for research, or what is called all members of the population if the population is relatively small, less than 30 people". Thus, researchers used 16 respondents/workers of PLN UP3 Gresik as samples in this study.[21]

Data Collection

In collecting research data this time, researchers or writers collect data based on two types of data, namely qualitative data and quantitative data, the following types of research data from researchers in this study.

Qualitative

Qualitative data is data that is not related to numbers. The results of this qualitative data are presented in verbal form, which will later be detailed into valid data.[22] This qualitative data is generated from observations in the author, which are recorded in certain minutes. As for the types of qualitative data, for example, the results of interviews, which are direct interactions with responses to ask about the topic of the research taken which results later in the form of minutes, observation is an activity to go directly to the field with evidence of documentation and observation minutes are carried out continuously according to the data needed in the research. [23][13]

Quantitative

In this practical work research, there is quantitative data, which is data related to or related to numbers or numerical data. Quantitative data is taken to fulfil the data needed in the report. The following is the quantitative data taken for research. [24]. The data taken by researchers for this study are two, namely workers' data sourced from company data and Nordic Body Map NBM questionnaire data where this questionnaire data is used as calculation data from the OWAS (Ovako Works Analysis System) method and also REBA (Rapid Entire Body Assessment). This questionnaire focuses on musculoskeletal muscle complaints experienced by workers, and later, the results of the questionnaire are calculated to determine the level of complaints experienced using the OWAS and REBA methods.

Results and Discussion

Before calculating with the OWAS method, the researcher makes observations based on the results of the picture. After identifying the complaints in the picture, the researcher distributed questionnaires to 16 respondents.[25] After knowing the results of the Nordic body map questionnaire, the next is the assessment of the work posture code of the respondent following the results of the assessment of the OWAS method work posture code:

Table 1. Results of OWAS Work Posture Assessment with Score 2

back	arms	1			2			3			4			5			6			7			legs
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Use office
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1
	3	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	3	3	2	2	2	2	3
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	4
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	4	2	3	4
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	4	1	1	1	1	1	1
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	4	3	3	3	1	1	1
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	4	1	1	1
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	4	2	3	4
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	4	2	3	4
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	4	2	3	4

The results of the recapitulation of the work posture code with the OWAS method state that there are complaints in 16 respondents on average, experiencing moderate-level complaints, and have a final score value of 2, so with the provisions of the OWAS method level, it is necessary to take corrective action to increase the ergonomic value at PLN UP3 Gresik. [26]

Next is the REBA method, which measures the value of the angle of the workers' activities. The following are the results of the images that have been given an angle assessment for analysis:

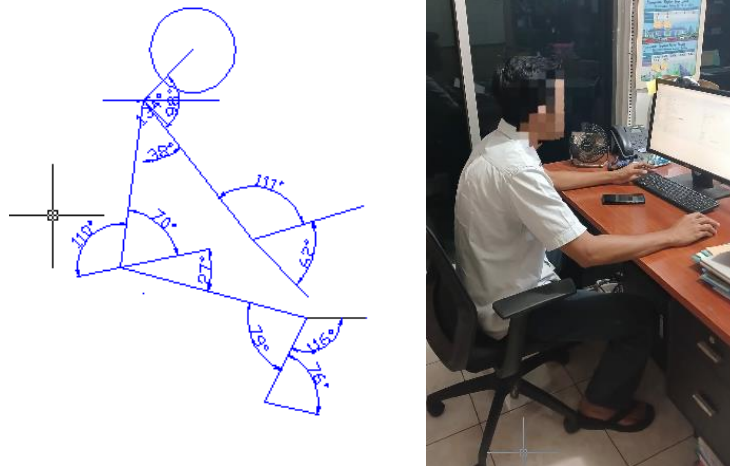


Figure 2. Activity Angle of REBA Method (worker operator at PLN UP3)

After measuring the angle of the work activity according to the picture above, the next step is to calculate the score value with the REBA method by determining the value of group A (Back, neck, and legs). The following is the explanation:

Figure 2 states that the position on the body forms an angle of 111 °, and the score obtained is 4 due to > 60 °. Furthermore, the last on a grub A is the position of the two legs, namely 1, and the knee is forming an angle of 116 ° so that 1 + 2 = 3. [27] For operators at PLN UP3 Gresik who are not lifting weights, the score is 0. The following is a recap of the results of group A of the REBA table, the following explanation:

Table 2. Grub A REBA Score 7

		Neck										
		1				2				3		
Trunk	Legs	1	2	3	4	1	2	3	4	1	2	3
1		1	2	3	4	1	2	3	4	3	3	5
2		2	3	4	5	3	4	5	6	4	5	6
3		2	4	5	6	4	5	6	7	5	6	7
4		3	5	6	7	5	6	7	8	6	7	8
5		4	6	7	8	6	7	8	9	7	8	9

After calculating the value of Group A, the total score is 7 + 0 = 7. The score which states 4 to 7, PLN UP3 Gresik is included in the level category that needs ergonomic corrective action. Next is the calculation of Grub B, which consists of such as the upper arm, which is at an angle of 38 °, the resulting score is 3, and the calculation of the forearm value is at an angle of 63 ° including a score of 2 because <60 °. [28] Then the angle of the wrist is 0 with a score of 1. The following is the Grub B table assessment in the study:

Table 3. Grub B REBA Score 4

		Lower Arm					
		1			2		
Upper Arm	wrist	1	2	3	1	2	3
1		1	2	3	1	2	3
2		1	2	3	1	2	4
3		3	4	5	4	5	5
4		4	5	5	5	6	7
5		6	7	8	7	8	8
6		7	8	8	8	9	9

The score of Grub B is 4, which is added to the coupling score, which is good because the coupling strength is good, and the score is 0. So, the total score of Grub B is 4 + 0 = 4, and according to the results, PLN UP3 Gresik requires corrective action to improve the ergonomic posture of its

employees. After calculating the scores of Grub A and Grub B, the next step is to determine the Grub C score by combining the scores of Score A + B, following the Grub C score results table.

Table 4. Grub C REBA Score 8

		Score B											
		1	2	3	4	5	6	7	8	9	10	11	12
Score A	1	1	1	1	2	3	3	4	5	6	7	7	7
	2	1	2	2	3	4	4	5	6	6	7	7	8
	3	2	3	3	3	4	5	6	7	7	8	8	8
	4	3	4	4	4	5	6	7	8	8	9	9	9
	5	4	4	4	5	6	7	8	8	9	9	9	9
	6	6	6	6	7	8	8	9	9	10	10	10	10
	7	7	7	7	8	9	9	9	10	10	11	11	11
	8	8	8	8	9	10	10	10	10	10	11	11	11
	9	9	9	9	10	10	10	11	12	11	12	12	12
	10	10	10	10	11	11	11	11	12	12	12	12	12
	11	11	11	11	11	12	12	12	12	12	12	12	12
	12	12	12	12	12	12	12	12	12	12	12	12	12

The REBA grub C value can be seen as the result of the summation of grub A and B with the final score of 8, and for body position activities is repetitive. Hence, there is an additional activity value of 1. The total score of grub C is $8 + 1 = 9$. So, score C indicates the need for action at PLN UP3 Gresik as soon as possible so that there are no musculoskeletal complaints among employees/workers. [29]

Proposed Improvements



Figure 3. Proposed chair design improvements

Proposed improvements to modify the design of chairs for seated workers to improve the posture of workers with designs such as the following:

With the proposed improvements to the chair design in Figure 3. Workers no longer feel complaints about the neck back and legs, because the chair is modified to fit the worker's body shape. Not only that, there is a proposed improvement for modifying the design of the table in the worker's sitting position to improve the worker's posture with a design like the following:



Figure 4. Proposed table design improvements

The proposed improvements to the design of the modified table are shown in Figure 4. Workers can use the table according to their height and the lower part of the table is wider so that it is not cramped when used.

Conclusion

The results and discussion above can answer the objectives of this research, namely analysing topics about work postures for the long term, using the OWAS and REBA methods at PLN UP3 Gresik, whether it is ergonomic or not. The results of the discussion state that action is needed for ergonomic improvement proposals so that workers do not feel prolonged muscle complaints. Improvements such as the replacement of table and chair designs based on the workers' data will make work more comfortable and productive so that the existing facilities are based on the ergonomic values of the employees. Also, the replacement of ergonomic table and chair designs is a long investment so that workers have no musculoskeletal muscle complaints.

In this study, using a relatively small sample size because the population is also relatively small makes findings for further research have a wider population value. Using the OWAS and REBA methods may already be representative in handling muscle complaints experienced by workers. Still, more complex methods to consider psychological values are also needed, as these impact job stress levels and satisfaction. So that more complex findings can be found to cover all factors in the research analysis.

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